

E S S A Y

ON THE

L I V E R P O O L

S P A' W A T E R,



By THOMAS HOULSTON, M.D.

*Mineral waters often produce cures, which we
in vain attempt to perform by the combinations in our
shops; even altho' these waters contain nothing but
IRON.*

Cullen's Lectures on the Materia Medica, p. 190.

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SIR GREGORY TURNER

BARONET,

(SON OF THE LATE

SIR EDWARD TURNER,

MEMBER FOR OXFORDSHIRE)

AS A MARK OF SINCERE FRIENDSHIP AND ESTEEM;

THIS ESSAY IS,

RESPECTFULLY AND GRATEFULLY INSCRIBED,

BY,

HIS OBLIGED

AND OBEDIENT SERVANT,

THE AUTHOR.

SIR GREGORY

P. R. BARONET

SON OF THE LATE

SIR EDWARD TURNER

MEMBER FOR OXFORDSHIRE

AS A MARK OF SINCERE FRIENDSHIP AND ESTEEM

THIS ESSAY

RESPECTFULLY AND GRATEFULLY INSCRIBED

TO HIS LORDSHIP

BY HIS LORDSHIP'S OBEDIENT SERVANT

AND OBLIGED SERVANT

THE AUTHOR

P R E F A C E.

THE Spring which has been discovered in the Stone Quarry on the south side of Liverpool, having been much talked of, and used by many with evident advantage, I thought it might not be improper to endeavour at ascertaining its component principles, and, thence deducing its probable medical virtues. Convinced, both by reason and experiment, that it promis'd no inconsiderable means of restoring and preserving health, I should have accused myself of inattention to the interests of humanity, and to the welfare of society, had I not used my best endeavours to promote and extend its use amongst my fellow citizens.

But what more particularly induced me to aim at recommending it to their notice, by this little publication, was the undoubted evidence I had collected of its having been of signal service, even in some desperate cases: some of these I have herein given, as the foundation of that confidence which I hope it may merit and obtain. Many mineral springs, both in England and abroad, possess'd of the like properties

P R E F A C E.

and principles, have acquired the highest reputation for their medicinal qualities and the cures they have wrought.

I would not wish to lay too great a stress upon the virtues of our Liverpool Spà, but rather, by ascribing to it simply those it possesses, and relating briefly and intelligibly some of the cases in which it has been found greatly beneficial, strive to excite the public to make a trial, which may at once procure reputation to the fountain, health to those who frequent it, and a heartfelt satisfaction to the proposer and promoter of it.

Liverpool, May 4th, 1773.



ESSAY



ESSAY

On the LIVERPOOL SPA WATER.

§ I. Of MINERAL WATERS in general.

WE distinguish by the term of *mineral waters*, those which are impregnated with some *mineral* principles, and hence are become *medicinal*.

They are properly divided into **SALINE, SULPHUREOUS, and METALLIC.**

We have found that those which have been termed *Spirituos* are indebted for that title, to a *gas*, or fix'd air only, to which they owe their sparkling, and that agreeable, pungent, acidulous taste, by which they resemble Champain. From this same principal they acquire the property they possess of dissolving metallic substances, as will be shewn hereafter. The peculiar acidulous taste which it imparts, has occasioned their being made, by some, a separate class under that denomination (*Acidulæ*) but, as it will appear, that

that there are no waters abounding with fix'd air which are not impregnated with other (mineral) substances, and as few instances can be produced, in which an acid uncombin'd is found, in any sensible proportion, in mineral waters, these distinctions seem superfluous, if not improper. The only instance I have seen of a mineral water really and abundantly containing an uncombined acid, is in a spring near Naples, call'd the Pisciarelli, where the water issues out very hot from the side of a volcano, and so acid as readily to corrode the surface of metals. But the acidulous taste depending on this fix'd air is met with even in waters, in which an alcali, uncombined, is found; as in the waters of St. Martin, in Roussillon, and La Marquise, in Dauphiny.

Many mineral waters in all the classes possess this fix'd air. The Seltzer water abounds with it, and is little impregnated with any other active principle; and hence the Seltzer water may be easily imitated by a very small addition of sea-salt and alcali to water saturated with fix'd air, separated, collected, and applied after the manner of the ingenious Dr. PRIESTLEY.

This is done still easier, by the process invented by that great French Chymist, VENEL, of adding the acid of sea-salt, in proper proportion,

portion, to water in which a very small portion of alkali is dissolv'd. No visible effervescence ensues (the mixture being so very dilute) but the fix'd air, as it separates from the combination of the acid and alkali, is absorb'd by the water, and impregnates it so, as to give with very little trouble, a tolerable imitation of, and succedaneum for, the Seltzer water.

But I will not dwell too much on these distinctions: my intention is not to write on the nature of mineral waters, but to point out the properties and effects of our own. Hence I shall only slightly treat of the different classes, as far as is requisite to convey a clear general idea of the nature and varieties of mineral waters, as an introduction to the examining and comprehending our Liverpool Spà.— And it may be useful in this place to observe, that we must not expect to find the several classes wholly distinct from each other; on the contrary, they are generally all more or less combin'd together, so that most commonly they can only be class'd from the principle which is found to predominate.

§ 2. OF SALINE WATERS.

STRICTLY speaking, perhaps, all the mineral waters might be termed *Saline*, as all containing more or less an alkaline, neutral, earthy, or metallic salt. But by this term we generally only understand waters, chiefly containing neutral and earthy salts in a sensible proportion, so as to prove purgative.—The waters impregnated only with selenites (i. e. vitriolic acid, and calcareous earth) which is the case with all our hard pump water, do not, I think, deserve to be considered as saline mineral waters; as instead of being improved by this admixture, they are rendered unfit even for most domestic uses. The good effects of Bristol water (which contains scarcely any other saline matter than selenites) are not to be attributed to its solid contents, but to the fix'd air it abounds with; which is also the case with respect to some other mineral waters, which, though they contain neutral salts, yet those are in too small proportion to answer any good purpose.—Water is impregnated with selenites by passing through gypseous earth and stones, consisting of selenites which are soluble in water.

An alkaline salt uncombined is rarely to be found in mineral waters, or when it is, its proportion

portion and effects are inconsiderable. The Tilbury, Clifton, and Seltzer waters, Eau de la Marquise in Dauphiny, and St. Jean's, have been considered as alkaline. The waters of this class, (if possess'd of any particular virtues) must be of service in all complaints arising from acidity, and act as attenuant, diuretic, and aperitive. Boyle, however, denied the existence of this class of waters in England.

The acids found combin'd in mineral waters are, the Vitriolic or Universal, and Marine or acid of sea-salt. The Nitrous is not found, nor do I believe, that the Volatile Vitriolic acid (uncombin'd at least) has ever been proved to exist in waters. Authors have labour'd long to prove the presence and escape of this volatile acid, and to reconcile thus the proofs that these acidulous waters contain a predominant alkaline basis. I find Hoffman, though he could not account for this, rejecting the opinion of a volatile vitriolic acid—*De Element. Aquarum mineralium rectè dijudicand. et examinand. p. 138, §. xi. Neque enim, quod primus omnium ego observavi, purum acidum in acidulis delitescit, sed omnes, quotquot sunt et dicuntur, in omnibus Europæ locis, sal alcali vehunt; ut potius alcalinæ dicendæ essent.*

The discoveries which have within these few years been made, chiefly by our own countrymen, respecting the nature and properties of fix'd air, have render'd this matter much easier to comprehend, than it was to former writers. When we find (with the Hon. Mr. Cavendish*) that fix'd air dissolves calcareous earth, and metals (with Mr. Lane*); that it gives a subtile spirit or gas, and a very acidulous taste to water, without impregnating it with any acid (as appears from Mr. Henry's Experiments), and when we see this air readily escapes and deposits the earth or metal with which it was combin'd, we shall soon be convinc'd that this is what former writers mistook for a volatile vitriolic acid. These properties of fix'd air will clear up at once all the difficulties they labour'd under, account for the seeming inconsistencies they strive to reconcile, and, probably, afford to future writers a much clearer and more eligible method of classing mineral waters, particularly if it should appear, as has been before hinted, that the medical virtues of many of these (as well saline as metallic) depend, chiefly, if not totally, on this principle.

* Philosophical Transact. 1765.

* Philosophical Transact. 1769.

But leaving this to those, who, *ex professo*, may hereafter take up the subject of mineral waters, I shall proceed with the combinations of the vitriolic and marine acid found therein; the most frequent of which is the latter.

The waters of the sea, and of salt springs, contain chiefly the marine acid, united with a mineral alkali, forming common salt, the uses of which, both domestic and medicinal, are considerable. Authors account for this impregnation from the immense rocks of fossil salt found in various parts of the globe, of which we have no inconsiderable specimens in our own neighbourhood.

The waters of this class are known by their salt taste. Some of the salt springs are nearly pure, and contain little else but pure salt, as the upper pit at Droitwich. Others are not free from earthy, and even metallic, mixtures, as those of Northwich in Cheshire, which contain some portion of Magnesia, Calcareous earth, and iron. The brine pits at Droitwich yield little earth and no bittern; the rest do, and from this bittern a bitter purging salt is obtained, to which we have given the name of Epsom salt, and which is Magnesia combin'd with vitriolic acid. 'Tis this salt (resembling Glauber's

ber's salt) on which depends the purgative quality of our several mineral waters, as those of Epsom, Cheltenham, Acton, Scarborough, Hartlepool, Stratford, (of Sedlitz) &c. A small proportion of calcareous earth, of an oily substance, and in some, a very little iron, make the rest of the substances which these waters are found to contain:

As well as the S E A W A T E R.

The proportions are various in the different waters. A pint of Epsom water contains about 33 grains of the purgative salt, and 6 of calcareous earth: Cheltenham, 46 grains of this salt, and 22 of calcareous earth, with about half a grain of iron (Ochre): Scarborough water contains nearly the same proportions as Epsom, but with a small quantity of iron and fix'd air. The purgative quality of sea water however, does not depend wholly on the quantity of this bitter earthy salt contain'd in it, for common salt alone, in sufficient dose, proves purgative. The whole of the two salts contain'd in a pint of our *sea water* is about five drachms, and a pint, a pint and a half, or a quart, is found necessary in different habits to act as a purgative.

All our salt springs are so much impregnated with saline substances, as makes it necessary to dilute them to render them tolerably agreeable

to

to the stomach; particularly, as the more the solution of these salts is dilute, the milder and surer is their operation.

The proportions in these springs also are various. The brine pit at Nantwich yields $\frac{1}{7}$, at Middlewich $\frac{1}{4}$, the strongest at Droitwich $\frac{3}{8}$, the weaker, $\frac{1}{4}$ part of common esculent salt, besides the Epsom salt (so call'd) which remains in the bintern.

As a substitute for the saline waters of Epsom, Cheltenham, &c. we may dissolve Epsom or Glauber's salt in water, in the proportion of half an ounce to a pint. But it is observed by Hoffman, Rutty, &c. that the effects of the salt so redissolved, are not above half what would have been produced, by such a dose of the water itself as contains that quantity of salt; and that these waters when boil'd to the consumption of half, are not proportionably increased in strength.

Where the sea water can be procured, it answers in general all the intentions of the waters of this class.

U S E S.

These saline waters are used either as alteratives or purgatives. They are attenuant, resolvent,

ent, cooling, aperient, and diuretic. They are beneficial in viscid foulnesses of the stomach and intestines, cleansing and stimulating, and hence frequently amend loss of appetite and of the digestive faculty, and stop vomiting; in habitual costiveness, pains of the stomach, heart-burn, colics; in removing obstructions of the abdominal viscera, as of the liver, spleen, &c. and principally in jaundice arising from this cause in promoting the menstrual and hæmorrhoidal discharges, in hysteric and hypochondriac affections; in vertigo and head-ache proceeding from a foul stomach, and in the epilepsy. In a sufficient dose they are excellent purgatives; they leave no constipation after their action, nor do they heat during it. They are peculiarly adapted therefore, as a cooling purgative in inflammatory and cutaneous diseases. They destroy worms by evacuating the mucus in which they live and generate, and by which they are defended against the action of vermifuge medicines. These waters are extolled by Musgrave in the gout, and by Ruffel, Rutty, and other authors, in a variety of obstinate chronic cases.

U N F I T.

They are improper in weak, delicate, habits, for persons advanced in years, for such as have weak breasts, diseas'd lungs, confirm'd tumours
of

of the viscera, or acrid juices; and hence in scurvy, strangury, dropsy, convulsive asthma, or asthma from water in the chest.

Great good effects are also experienc'd from their use *externally*——So much has been wrote in praise of *sea bathing*, that I shall say little on that head, as its efficacy in preserving health and strength is generally known and confess'd. It will be found to coincide, in its effects, with those of our Spá Water.

Nor is its efficacy only to be deduced, as being a *cold bath*. The salt, besides adding to its gravity, has been thought to be beneficial as a topical application. Hippocrates thought it in many cases more efficacious *warm*, as in contractions, indolent tumors, paralytic and dropical affections. Fortunately we are so situated, as to enjoy very desirable conveniences for sea bathing both cold and hot, * and it is to be hoped, that such facility will by no means cause us to despise

* A *hot salt water Bath* is at any time prepared at our baths, on giving an hours notice; an advantage this, which should not be confined to cases in which *salt water* may be thought serviceable, as it is certain great good effects may be expected in many complaints from the use of a *warm bath*.——I am entirely of opinion with the ingenious Dr. Percival, that we do not, in England, consider warm bathing as highly, or use it as frequently, as it deserves. Abroad, much benefit is both expected and experienced, from its more frequent use in diseases.

and



and neglect a powerful means of preserving and restoring health, which others, at a distance from such conveniences, know how to set a proper value on, and are at considerable pains to come and partake of.

§ 3. Of SULPHUREOUS WATERS.

THese are impregnated with the liver of sulphur (i. e. sulphur combin'd with a mineral alcali, or a calcareous earth, and thus rendered soluble in water) and are easily distinguished by their foetid smell, and disagreeable taste, resembling rotten eggs.

Of this class are those of Harrowgate, Moffat, Aix la Chapelle, of D'ax, Bourbon, Mont d'or, St. Amant, Baresges, Bonnes, Cauterets, Chaudes, Arles, and Alais in France, of Swadlingbar, of Baden in Lower Austria, of the Geronster at Spà, of la Solforata and some others near Rome, and several I have met with in Germany and Italy. The vapors from these waters blacken silver, and heighten the colour of gold, some of them almost instantaneously on exposure. Some are pellucid, others of a milky colour; but they deposit a whitish cloud on the addition of an acid. On their surface a gold-colour'd, beautifully variegated, pellicle is observed.

The

The fulphureous waters may be imitated not unaptly, by adding to a drachm of the flowers of sulphur, a grain of lime or calcin'd magnesia, or six grains of salt of tartar, rubbing them together, and infusing them in a quart bottle, not quite filled with water, for eight or ten hours in a gentle heat; or by boiling an ounce of sulphur in twelve pints of fresh made lime-water. The dose of these is from three to four Pints.

We have three sulphureous [saline] waters in Lancashire: 1st. Maudsley near Preston, which is blue, intolerably foetid, and contains 930 grains of common salt in a gallon: 2d. Braughton, between Skipton and Coln, of a whitish colour, the gallon yielding three drachms of salt: and 3d. Crickle Spà, a Mile from Braughton, which is clear, very foetid, and contains 308 grains of salt in a gallon. From the quantity of salt contain'd, they all prove purgative.

U S E S.

The waters of this class invigorate, lightly affect the head on being first drank, and generally inspire gaiety and chearfulness, which are sometimes followed by drowfiness; they raise the spirits and promote an appetite. They attenuate, stimulate and cleanse, promoting digestion, perspiration and the regular natural discharges, and

hence

hence are useful in that variety of complaints which arise from indigestion, acidities, foulnesses, &c; to persons in whom the circulation is slow and languid, and where there is laxity of the solids, debility of the stomach, or acrimony in the first passages. Hence, also, they are recommended in obstructions of the viscera, or of the glands, in cold defluxions, constipation, to destroy worms, and to cure intermittents; in suppression of the menstrual and hæmorrhoidal discharges, in melancholic, hypochondriac and hysteric cases, in cachexy, dropsy, scurvy, scrophula, gout, stone, palsy and nervous affections. In external complaints, as in foul ulcers, cutaneous eruptions, tetter, the itch, and in retrocession of cutaneous eruptions, they are much extolled.

After their use, if they have left the body in a relaxed state, it may be necessary to have recourse to cold bathing and strengthening remedies, such as bark, &c. in order to restore the tone of the fibres.

U N F I T.

They are improper in inflammatory and very irritable habits, in bilious, hectic, and feverish complaints, in ulcers, tubercles, or infarctions of the lungs, in convulsive coughs and violent
asthma

asthma from extravasated fluids, and in a disposition to hæmorrhage and apoplexy.

We come now to the third and last class of Mineral waters, viz. the *Metallic*.

§ 4. OF METALLIC WATERS.

THESE have been sometimes stiled *Vitriolic*, as being all impregnated with a metallic substance dissolv'd in the vitriolic or universal acid. But those who have adopted this term were unacquainted with the solvent property of fix'd air. However, the vitriolic is the acid most frequently found in metallic waters, and is therein combin'd with zinc, copper or iron, Water is impregnated with these principles by meeting, in its passage, with Pyrites (or Fire-stone), in a state of decomposition. The particular metal will depend on the nature of the Pyrites.

The combination with zinc is rarely met with; — that with copper not frequently, and as these have not been regarded as medicinal, it suffices simply to have enumerated them. The

waters of Neufol in Hungary, of two springs in the county of Wicklow in Ireland, and of one in the Isle of Anglesey, contain the vitriol of copper. The copper is obtained from them for sale, by adding to them iron : this is dissolv'd by the vitriolic acid, which deserts the copper, and suffers it to precipitate.

But no impregnation is more frequently found in mineral waters than that of iron, either dissolv'd by the vitriolic acid, or by means of fix'd air, which has been generally consider'd as volatile vitriolic acid. These waters, to which we give the names of Martial, Ferrugineous, or Chalybeate (the latter very improperly, as steel, i. e. *chalybs*, is not a natural, but an artificial production) are easily known by their astringent, styptic, taste, and by leaving on the stones, &c. thro' which they run, a reddish or rust-like ochre. But if they be added to any astringent vegetable juice, as the infusion of tea, galls, &c. they betray at once their nature by striking a black, inky, colour.

Iron, is at once the hardest, most common, useful, perfectly innocent, and easily soluble, of all the metals. And hence we need not wonder at the number of mineral waters of this class which are in high repute, such as
those

those of Pyrmont, Spá, Malmendy, Bath, Tunbridge, Hampstead, Islington, Carlsbadt, Cleves, of Passy in France, of Schwalbach in Hesse, of Freyenwald near Berlin, and many others.

In some of these the iron is dissolv'd by the vitriolic acid, in others by fix'd air, and in many partly by each of these. The latter waters are such as, on standing, or boiling, precipitate an ocre, yet still retain, though in a less degree, the astringent, styptic, taste, and the property of striking black with galls. But it is remarkable that so very small a proportion of martial vitriol, as one grain in a gallon of water, is sufficient to produce the change of colour with galls to a darkish blue.

Waters strongly impregnated with the vitriol of iron are not frequently met with, but those of Rammelsberg in Hungary, are considerably so. Such, however, are not fit for medical uses.

The waters of this class might be imitated by dissolving a proper, small, proportion of the vitriol of iron in pure water. I say, *small* proportion, because there seems reason for ascribing the good effects of martial waters, to the iron being thus administer'd in repeated small doses.

But

But as we are at no loss for chalybeate waters, and as nature is far more perfect in her combinations than we can be, it will rarely be necessary to imitate her in this.

U S E S.

The effects are, those of iron in general, which we shall reserve for the next article.

2. Iron is dissolved in mineral waters, also by means of fix'd air, without the intervention of any acid. This, which is only a late discovery, has formerly been the occasion of much perplexity; and authors finding some chalybeate waters evincing marks of a predominant alkali, have endeavour'd to account for this seeming contradiction by ingenious fictions, of a *volatile vitriol*, or (with somewhat less absurdity) by supposing them to contain iron dissolv'd by means of the volatile vitriolic acid, which, on exposure to air, or heat, flying off, left the iron and suffered it to precipitate. Pity it is, that systems should not only be fram'd, but for a succession of years implicitly adopted, which have never undergone the test of experiment, and which, by one of the most simple and obvious might easily have been confuted. Unfortunately for this system, it appears by experiment, that iron, when dissolv'd by means of
volatile

volatile vitriolic acid, will bear not only exposure to the air, but even a boiling heat without either the vitriol or the acid totally flying off. And where iron is dissolv'd by the fix'd air only, the air when at liberty soon flies off, the iron (in ochre) precipitates, and the water no longer strikes a black colour with the vegetable astringents.

Many chalybeate waters (even such as contain iron dissolv'd in an acid) contain the iron also dissolv'd by means of fix'd air, as those of Spá, Pyrmont, Tunbridge, Bath, Cheltenham, &c. And such as contain no iron, but only fix'd air, as those of Buxton, Písa, Seltzer, &c. are found readily to dissolve iron filings, tho' they evidently contain no acid.

By this means, or, by impregnating water with fix'd air, after the manner of Doctor Priestley, we can imitate perfectly well, the Chalybeate waters of this class.

U S E S.

Of the latter chalybeates, some of the medical virtues are to be deduced from the action of the *fix'd air* contain'd in them. This warms, exhilarates, invigorates, restores appetite, good digestion, proper circulation, and necessary secretions.

cretions. It removes obstructions arising from a languid circulation, and restores to the fibres their tone and elasticity. It is an excellent stimulus, and a powerful corrector of any putrid tendency. From its active, subtil, penetrating nature, much may be expected, in hysteric, hypochondriac, and nervous habits; in the rheumatism, gout, palsy, and in many consumptive cases.—But from the *metallic principle* contain'd in the waters of this class (of which we shall demonstrate the Liverpool Spâ to be one) considerable good effects may be expected.

Iron is astringent, and antispasmodic in small doses; it is tonic and strengthening, acting upon the fibres and vessels of the stomach and intestines, and hence is excellent in diseases caus'd by laxity, debility, and inactivity of the digestive organs, such as crudities, bad digestion, accompanied with flatulence, colics, fluxes, &c: in case of general laxity and debility, and in hysterics, unless there be invincible obstructions of the viscera; in intermittents, in the scurvy, in obstruction, and defect of secretion and excretion caus'd by weakness and relaxation of the fibres, as in rickets, scrophula, chlorosis, some kinds of jaundice, &c. It speedily remedies loss of appetite, strengthens the stomach and intestines, destroys worms, and cures obstructed menstrua.

menstrua. But it must be remembered, that this change of the tone, and spring of the solids, cannot be effected but by a continuance of the martial remedy, in small doses, for some considerable time, otherwise only a temporary relief will ensue.

Some of these vitriolic waters are good to stop Hæmorrhages, particularly one at Haigh in Lancashire, one gallon of which is found to contain 1920 grains of white and green vitriol.

U N F I T.

Wherever there is rigidity of the solids, an increas'd impetus of the fluids, plethora, or a disposition to inflammation, this medicine is improper. In hectic fevers with a spitting of blood, it is little to be relied on, as, by encreasing the tone, it may easily increase both the fever and hæmoptoe.

§ 5. On the LIVERPOOL SPA.

THIS water springs, or ouzes, through veins of that soft yellow stone generally used here for building and which owes its colour to the iron which it contains. This stone hardens in

the air, and when calcin'd, is of a red colour. There are several springs in this quarry, though situated very high, but none so much impregnated as the one resorted to. * The water trickles slowly into an irregular bason (which might be much enlarged) containing about four gallons. It is naturally limpid, tho' frequently found otherwise, owing to the ochre, which it deposits on the escape of the fix'd air, and as it is exposed to the air and weather exhibits different appearances; and different proportions of mineral contents, at different times. Its taste is at first cool and refreshing, afterwards austere and inky, and it does not lose the irony taste by long keeping in open vessels, though it soon deposits a quantity of ochre. Some time after it has been drank, it is found by many to warm the stomach, and some think they experience from it, both a cordial, and lightly inebriating, sensation. It has no smell, and will keep a long time without putrefying. It is one of those chalybeates which lose least by keeping, and that part of the iron which subsides is so minutely divided, that, if swallowed, it is readily re-dissolved in the stomach. To investigate more fully the nature and contents of this water, I submitted it to the following Experiments.

* A smaller one near it is used for external applications, to wash the eyes, ulcers, &c. and contains iron, but in smaller proportion.

E X P E R I M E N T I.

A glass of the Liverpool Spá Water exposed to the air for 24 hours, deposited a quantity of an ochrous earth, which, on adding an acid, redissolved perfectly. The same thing happened, but in a shorter time, by placing a glass of this water in a moderate degree of heat (a water bath) a number of air bubbles, and a deposition of ochre followed in a short time. This deposition was effected still sooner by boiling.

This experiment seems to prove, that a portion of the iron contain'd in this water is kept in a state of solution, by means of *fix'd air*, the escape of which being permitted by exposure in open vessels, or promoted by exposure to heat, the iron so dissolved is soon precipitated. That the whole, however, of the iron contain'd is not dissolved by *fix'd air*, appears from the following experiments.

E X P E R I M E N T II.

To the water boil'd, a little tea, or a few drops of the infusion of galls being added, gave a blackish purple colour; to that which had stood some hours in the water bath, a much deeper, for the black colour produced in this, from the above additions, was nearly equal to what appeared on their mixture

with the water which had only been exposed to the air. The inky colour is in all much heightened by standing, and the more so, when the water is fresh taken from the spring, and when not diluted by accidental circumstances. This water, therefore, will always contain a greater proportion of the metallic principle in a state of solution, the fresher it is drank.

EXPERIMENT III.

Fix'd alcali (pot ash) added to some of the water boil'd an hour, caused a small quantity of ochre to precipitate; from the water exposed to a moderate heat, a greater quantity; from that exposed to the air only 14 days, still more; and from the fresh water immediately a considerable portion was separated. Hence 'tis plain that besides iron dissolved by means of a volatile solvent, this water contains also that metal dissolv'd in an acid, from which it is readily separated by the addition of an alkaline salt, which has a greater attraction, or affinity, to acids, than metals have.

EXPERIMENT IV.

A gallon of the water collected soon after a heavy rain, and which seem'd weaker than ordinary, both to the taste, and to other trials,

was

was suffer'd to remain in open vessels, till it had deposited its ochre, which, when separated by filtering, weigh'd four grains: It was then evaporated in a glass vessel with a gentle fire, and when reduced to a fourth part, was filter'd again; four grains of ochre remain'd in the filtre, yet the clear liquor proved, on the addition of galls, &c. that it still retain'd a portion of iron.

EXPERIMENT V.

The *same* water, evaporated to half a pint and filtred, was of a reddish colour, and struck black with galls. The remaining part of the evaporation was made in a water bath, and as it proceeded, a quantity of salt kept rising to the surface, forming a shining pellicle, and subsiding. When reduced to about two ounces and cool, it was examined in the microscope, and * chrystals, resembling needles, were observed ranging themselves into a star-like form. The last drop of fluid remaining, examin'd in like manner, gave cubical chrystals. The whole had, towards the end of the evaporation, a greenish colour, and vitriolic smell, and some of the chrystals which had form'd on the sides of the vessel

* Nice Microscopical Observations on the different forms of chrystallizing salts, might probably contribute not a little to the readily distinguishing the different kinds, and thus assist both analyzation and metallurgy: at least, this subject offers a scope for highly curious and entertaining experiments.

deliquesced

deliquesced (i. e. absorbing moisture from the air, re-dissolv'd)—The quantity of solid contents were,

Of ochre which subsided, four grains;

Of ochre separated by boiling and filtering,
four grains;

Remaining when evaporated to dryness, twenty grains;--- in all 28 grains; whereas the total of solid contents in a gallon of Tunbridge water is only nine grains, and sometimes much less; and of the Geronster at Spà, 24 grains. (Rutty.)

EXPERIMENT VI.

The whole of the solid contents remaining on evaporating to dryness, were washed with hot water, as long as they yielded any saline impregnation to it. The filtered liquor, at first was of a deep amber colour, inclining to green, and struck black immediately with galls. It did not suffer any sensible alteration with acids, nor make any immediate change in the colour of syrup of violets, but an alkali precipitated from it a green powder, and in short it gave, on every trial, undoubted marks of its containing martial vitriol (or iron dissolv'd in the vitriolic acid) and that in such proportion, as, I believe, would justify my asserting the Liverpool Spà, to be one of the most powerful, pure, and perfect chalybeates,

beates, in use, in England ; not liable, as many are, to lose its virtue by keeping.

E X P E R I M E N T VII.

The water in which the salts were redissolved, as in the last experiment, was again evaporated; and the salts chrySTALLIZED, nearly in the same order as before. Those which chrySTALLIZED first, struck a much deeper black with galls, than those which formed only towards the end of the evaporation. There had remained in the filtre, a fine grey powder, which did not effervesce with acids, and turned black on a hot iron. This weighed one grain---Of the salts much the greater part was martial vitriol. They did not effervesce with acids or alcalies sensibly : on the hot iron they scarcely decrepitated, but turn'd of a deep red colour, like colcothar, emitting a slight fume. This calcin'd matter was mostly insoluble in water, and also in acids, yet had a saltish taste.

The other salts joined with the martial vitriol in this water, are in so small proportion, as to merit but little attention in the analysis, and still less the enumeration of various experiments, *proving what they are not*. I have reason to believe, however, they consist of the marine acid, combin'd

bin'd first with iron, (deliquescing) and secondly, with magnesia, or calcareous earth.

EXPERIMENT VIII.

The Syrup of violets added to this water produced no immediate change of colour, * no more than the red juice of the rind of radishes, a proof that neither an acid nor an alkali uncombin'd, is contain'd in it, since a drop of dilute vitriolic acid caused the mixture immediately to turn a bright red, and a small portion of alkali rendered it green. Boil'd with milk, it does not coagulate it, but encreases its sweet taste: it lathers also with soap; further proofs of its containing no uncombined acid. I think, however, I have observed, on mixing the red juice of radishes with the water which had undergone a long evaporation in glass vessels, and deposited much ochre, that the red colour was heightened, as if an acid then predominated.

* After standing some time it became of a sea green; but we must observe that this change of the blue juices to a green, is effected, not only by a predominant alkali, but also by the solutions of Iron, in the fix'd or volatile vitriolic acid, or in fix'd air.—May not the want of attention to this circumstance have given rise to confusion and mistake on the subject?

EXPERI-

EXPERIMENT IX.

Caustic volatile alcali was added to the Liverpool Spà Water. An ochrous precipitation ensued, but no change of colour: a proof that it contains no copper, for if it did, a beautiful blue would have been produced on the mixture.



§ 6. REMARKS and EXPERIMENTS,
on the VOLATILE SOLVENT.

WE have hitherto taken for granted, that the Volatile Solvent in Chalybeate waters, was fix'd air, and have postponed, to the article of experiment, the reasons for denying it to be the volatile vitriolic acid, and for concluding it to be fix'd air. As this is a subject which has as yet been little canvassed, and as a contrary opinion is still maintained by men, whose ingenuity, learning and reputation give weight to their theory, it seem'd but just, to consider this matter a little more minutely.

Till within these few years the nature and properties of fix'd air were little, if at all, understood: and Mr. Lane first, in the year 1769, publish'd to the world, that it was capable of

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dissolving

dissolving iron. Before that time, as no other solvent, of a fugitive nature, was known, except volatile vitriolic acid, authors attributed to *it*, the solution of iron in such chalybeate waters, as, on standing a short time exposed to the air, deposite their metallic contents, and lose their consequent virtues: and even later authors on this subject have been so far influenced by the authority, and prevailing opinion, of their predecessors, as to adopt this conclusion without sufficient examination, or the shadow of proof. For, in reality, the existence of this volatile acid in chalybeate waters has never yet been fairly proved by experiment, and perhaps will be found to be, the child of invention, adopted by necessity, and fostered by ignorance of the truth.

The inconveniences and absurdities derived from supporting this theory are apparent in most works on the subject. We need look, for an instance of it, no farther back, than in that elaborate author, Rutty, p. 325, on the waters of Spà, he writes thus: "they contain a good deal of air, and a volatile acid, discoverable by the taste,--and at the same time,--an alkaline salt predominating over the acid, as is evident from the appearances exhibited, &c."

But

But a later very learned and ingenious writer, who, is well acquainted both with chemistry in general, and with the doctrines relative to fix'd air, Dr. Falconer of Bath, though he proves the presence of "fix'd air, in considerable proportion," in the Bath waters, yet attributes the solution of iron therein, rather to volatile vitriolic acid, than to it. In his *Essay on Bath Waters*, p. 220. *2d Edition*, he gives an easy method of ascertaining the presence of the volatile acid, viz. by adding Magnesia, with which it effervesces. But this will by no means determine whether the iron be dissolved by volatile, or fixed vitriolic acid, as, in the preceding paragraph, we find this effervescence proposed as a test of the latter also.* Yet by his 16th. Experiment, it appears that Bath Waters did not thus effervesce. This then cannot amount to a certain proof of the volatile acid being the solvent; no more can the partial decomposition, and deposition of ochre on standing, as the same thing happens also from a dilute solution of iron, in the fixed vitriolic acid.† A remark made by

* I apprehend here is some mistake. With respect to the volatile vitriolic acid, there certainly is, as the combination of that with Iron, however concentrated, causes no such effervescence. Neither does our Spa Water, nor a solution of martial vitriol in water.

† One grain of martial vitriol, dissolved in half a pint of water had a considerable deposition on standing.

the Dr. p. 186, seems to offer a means of determining the question; viz. that fixed air dissolves iron and not copper, volatile vitriolic acid, dissolves both very plentifully. But in making the experiment, an observation made by Dr. Percival, must be remembered, "that the fixed vitriolic acid when its salts are diluted, is separable and dissipated by a boiling heat."

The presence of a volatile vitriolic acid being by no means proved, it can only be said to be implied by analogy, or supported by probability. Let us see then, if we shall not find, even in the Doctors Essay, reasons for asserting, that these make in favour of fix'd air as the solvent. P. 294, he tells us that "Bath Water poured on iron filings dissolves them plentifully; yet p. 261, that this water most probably contains no acid uncombined, or if any, not above a drop in many pounds, and—that the vitriolic acid does not remain in the water in its separate state." If so, what does it contain capable of dissolving the filings of iron plentifully, but the fix'd air? The learned author allows, p. 186, that the volatile vitriolic acid, though a possible, is, nothing near so frequent an impregnation (of mineral waters) as fix'd air.

For

For farther light on this subject, and to *prove*, if possible, that the volatile vitriolic acid is not the solvent in such chalybeates as lose all their metallic impregnation, on a short exposure to the air; I procured about half an ounce of volatile vitriolic acid, by destilling in a sand heat, with the greatest care, in glass vessels, two ounces of vitriolic acid, from a little charcoal. It came over colourless, and scarcely acid to the taste, diffusing through the whole house a pungent, suffocating smell, like that of a burning match. It did not effervesce with the mildest alkalies, nor with Magnesia. Instead of changing the blue juices red, as it did before distillation, it deprived them, and the red flowers, of all colour; the mixture however became of a bright red, on standing 24 hours; this circumstance naturally suggested the following,

EXPERIMENT X.

A few drops of this volatile vitriolic acid, was diluted with an ounce of water, and suffered to remain in a glass open to the air, for 24 hours. The blue juice of the Iris was then added, and immediately changed to a bright red.

When this happened in the former experiment, it might be supposed, that the volatile acid was retained and fixed by the blue juices,
but

but in this no such detention is to be apprehended. We see then clearly, that *volatile vitriolic acid*, when diluted, and *exposed* some time to the air, instead of flying off, as was supposed, becomes *fixed*. How is it probable then, it should so soon dissipate in mineral waters, wherein, besides being in a like state of dilution, it is combined with, and retained by iron?

But the following experiment proves beyond a doubt, that the volatile vitriolic acid is *not* the solvent, in such chalybeates, as readily lose, on exposure to the air, their metallic principles.

EXPERIMENT XI.

To a pint of spring water were added, ten drops of the volatile vitriolic acid, which had remained twenty hours on fresh filings of iron, and which seemed fully saturated with the metal. The mixture struck a fine purple with galls. One half of it was immediately boiled on an open fire, in a Florence flask, for a quarter of an hour and filtered, it then struck a deeper purple with galls than before, and continued so to do when evaporated almost to dryness, after standing in a basin twenty one days. A piece of paper dyed blue, and put in the neck of the flask, had lost its colour, which did not happen on the evaporation of our Spa Water.

The

The other half stood in a basin twenty four hours, without scarcely any ochre subsiding, and, after remaining exposed to the air about three weeks, struck instantly black with galls. Its taste was like that of our Spa Water, but a little sulphureous.

EXPERIMENT XII.

A fresh mixture, of the solution of iron in the vol. vitriolic acid, with water, was evaporated to dryness by a gentle heat. The dry remainder consisted partly of ochre, and partly of a saline substance, which chrystallized in a star-like form in the microscope, similar to what we observe in a solution of iron, by the fixed vitriolic acid, when evaporated to dryness. The salt had an astringent taste, turned black with galls, green with the blue juices, and precipitated an ochre on adding an alcali to the solution of it. Is it possible after this to suppose that a solution of iron in vol. vitriolic acid, is so readily and perfectly decomposed, by exposure to the air, as hitherto has been taken for granted; or is it not rather clear, that 'tis as difficultly decomposed, as that with the fix'd acid?

A remark made by Mr. Lane, coincides perfectly with the above experiments, and, as appears from thence, extends also to the volatile acid.

acid. Philos. Transact. 1769, page 222.—
 “ Where iron is suspended in water by an acid,
 “ neither exposure nor boiling will destroy its
 “ property of tinging with galls, which is the
 “ reverse of what we find to be the case with
 “ many ferrugineous waters.”

Of this nature is one in the neighbourhood of Crosby (at Holmer Green, in Thornton) which strikes instantly a Burgundy colour with galls, exactly similar to that, which a dilute solution of iron by means of fix'd air produced. This chalybeate, when kept three days, had lost all its metallic impregnation, and with it, its power of tinging with galls. It is constantly drank, and used for all domestic purposes, by a very healthy family, who prefer it to any pure water. There is another of the same kind near it, (at the Lunt): both of these owe their metallic impregnation to fix'd air, as may be inferred from the following,

EXPERIMENT XIII.

Ten grains of iron filings stood three days in four ounces of water impregnated with fix'd air. The iron was scarcely diminished in weight, but an ounce of this solution gave, to a pint of spring water, the taste and properties of a chalybeate, such as the Crosby Spá; it struck the
 same

same colour with galls, and, *like it*, when kept three days, lost this property entirely.

Fix'd air then is capable of dissolving iron, and that metal, so dissolved, communicates to water, properties, evidently corresponding with those of the chalybeates which readily spoil by keeping. Yet the following seems to prove, that fix'd air is not, in its nature, an acid, nor is any acid carried up into the water, during its impregnation with fix'd air.

EXPERIMENT XIV.

Four ounces of water were saturated with fix'd air, and obtained an acidulous taste, yet did not, even on standing, make the least change in the colour of syrup of violets, nor of the juice of the Iris, though that is one of the best tests of an acid. Nor could I, by transfusing, for a long time, fix'd air separated from a mixture of chalk and vitriolic acid, into water dyed blue, produce the least change in the colour towards a red. On the contrary, the blue colour was discharged, a bluish sediment formed, and the water became entirely colourless. The fix'd air, herein, seemed to possess the property of volatile vitriolic acid, of destroying the colour of flowers; for a piece of the blue Iris, infused

in the water impregnated as above, was deprived of its colour, without communicating any tinge to the water.

Dr. Falconer, in his Essay, p. 314, admits that "fix'd air changes to a red colour the blue juices, and that it is not improbable, that an acid is always either united with, or makes part of, the composition of fix'd air." But does not his experiment, p. 143, of fix'd air dissolving iron diffused through a solution of mild alkali, prove the contrary.

Having, I hope, proved, that volatile vitriolic acid *can not* be the solvent, in fugitive chalybeates, and offered reasons, and experiments in support of fix'd air being the solvent, we should now, apply this to our Liverpool Spà, and, if possible, bring proof of the existence of this principle therein. But it may perhaps, not be so easy to collect positive proofs of it; first, because, from the nature of its situation, the greatest part of its fix'd air must escape, whilst the water trickles down the side of the rock, which is, hence, cover'd thick with the ochre deposited, and whilst it remains quite open to the air: secondly, because it is naturally contained therein, in very small proportion united with the iron. We found
by

by experiment 13th, how very small a proportion of iron dissolv'd by fix'd air, was sufficient to imitate a chalybeate water of the fugitive kind. A still less proportion may be expected in waters, which are besides impregnated with martial vitriol. These circumstances render it difficult to collect the fix'd air in sufficient quantity, so as to prove indubitably its existence by any experiment.—Let us see how far analogy and probability will assist in supporting this position.

Mr. Worthington, in his experiments on the Liverpool Spà, publish'd during the printing of these sheets (by which I find we were both employed on the same subject, unknown to each other) gives up, seemingly with reluctance, the opinion of fix'd air, being the solvent of a part of the iron in this water. Yet the following passages, in his work, seem to corroborate the truth of it. P. 14, he makes this ingenious remark “ the colour of the water is altered, from the greater or lesser degree of elasticity in the air; the more elastic, the brighter, and from the want of elasticity, the more opaque.” It is certain, that when the air is most elastic, it will most powerfully counteract and impede the dissipation of the fix'd air, which keeps part of the iron in a state of solution; on the contrary, when the air is less elastic, the fix'd air, being

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more

more at liberty, will sooner fly off, and the ochre precipitate, and occasion the water to become turbid. But it by no means appears that this would be the case if the iron was dissolved by the volatile vitriolic acid ; see experiments 11, 12.—How otherwise than by dissipating the fix'd air, can “ the suns influence impair its virtues, or injure its qualities, by a partial decomposition,” as he observes it does, p. 15, 24. I have before explained the difficulties which oppose themselves to our attempts to demonstrate, by experiment, the existence of fix'd air in the water. Hence 'tis no wonder if Mr. Worthington's experiment with lime water, did not succeed to prove it. The German Spà, and some other of the like chalybeates, contain not only fix'd air in union with iron, but a superabundance of fix'd air uncombined, these waters spring out in large quantity, and proper steps are taken to prevent the evaporation of this volatile principle, and hence, we find them exhibit sensible proofs of their containing fix'd air. But Mr. W. admits that the Liverpool Spà, though without these advantages, contains “ an extraordinary quantity of common air exceedingly elastic, so as, when held before the fire, to force the cork, with some explosion, out of a vial three fourths filled.” What common water, equally exposed, contains so great

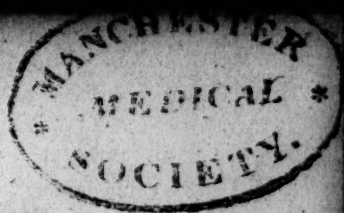
a quantity? A strong presumptive proof in favour of our argument might be deduced from his 13th. experiment, p. 20, where "fix'd or mephitic air transfused, restored the spoiled water," by redissolving the ochre precipitated on exposure to the air, and by this means, as we find p. 22, it "recovered its qualities more perfectly than by the addition of vitriolic acid," had not Mr. Lane, in the *Philos. Transactions*, 1769. Exp. 2. p. 218, tried in vain to redissolve by means of fix'd air, the ochre precipitated; which was soluble in the vitriolic acid; and if, on repeating the experiment, I had not been equally unsuccessful. For I find, not only fix'd air does not redissolve the whole of the ochre precipitated, but that neither the volatile vitriolic, nor marine acid, does it other than in part. But tho' fix'd air does not perfectly redissolve the ochre, yet it certainly does in part, for the spoiled water, which before gave only a faint blackish tinge with galls, when impregnated with fix'd air, gave, in the same proportions, a beautiful purple colour. Does not this seem as if we restored to it its properties, by replacing what it had lost on exposure?

The following may perhaps be deemed not unworthy a place here as a presumptive argument in favour of fix'd air, one of the principle properties

perties of which is, its resisting and correcting the putrefaction of animal substances.

EXPERIMENT XV.

A bit of the lean of lamb, in weight half a drachm, was put into a phial, close cork'd, with two ounces of the fresh Spa Water; a like piece was put into an open vessel, with the same quantity of Spa Water; a third, into two ounces of our best pump water; and all three were placed in a warm room. In 48 hours, that in pump water, began to acquire a putrid smell, and in four days became quite foetid. Four days were compleated, before that in Spà Water exposed to the air, became offensive; the fibres seem'd corrugated, and there was a shining scum on the surface: in two days more, it was to the full as foetid as the former. That close corked, open'd the 10th. day, was scarcely offensive, nor rose to the surface: the 13th. day, the bottle was broke by accident; the meat was by no means putrid, but rather harder than when fresh, and infused in fresh Spà Water, open to the air, did not become putrid till four days more were expired. It would seem then, that this water resists putrefaction, and the more powerfully, when the escape of the fix'd air is prevented.



EXPERIMENT XVI.

A phial containing five grains of the bright filings of iron, was filled with four ounces of the freshest Liverpool Spá Water, close corked, and kept with the mouth downwards, two days. The iron visibly attracted bubbles of air, and with them, particles of it were carried up to the surface. The water was then filtered and struck with galls, a much deeper purple than the fresh Spa Water did; the iron remaining in the filtre, did not seem to be at all diminished in weight, when accurately examined; in this respect resembling Antimony which gives a strong impregnation to wine, in which it is infused, without suffering any sensible diminution.

We have already seen that this water contains no acid uncombined, and hence we can only attribute the solution and additional impregnation, to the action of that small portion of fix'd air uncombined, which remains in the water, upon the iron. Is not this then a stronger presumptive proof in favour of fix'd air, than any which has been advanced in favour of volatile vitriolic acid?

EXPERIMENT XVII.

In a former experiment, [13] fix'd air combin'd with iron, was found to produce a burgundy colour,

lour with galls, and there is reason to believe that chalybeate waters give a reddish tinge in proportion as they contain fix'd air, whereas vol. vitriolic acid and iron gave a blackish tinge. The following, are the appearances produced by the addition of a grain of powdered galls, to two ounces of each of these waters.

Fresh Crosby Spà Water; } a Burgundy co-
Artificial fix'd air chalybeate, } lour immediately.

These, when exposed 3 days, } no change of colour

Artificial vol. vitriolic chaly- } immediately
beate, after standing 14 days, } blackish.

Liverpool Spá Water, ditto } a blackish purple.

Do. fresh { at first, a Burgundy
 { or claret.

Do. which had stood two { a much deeper claret
days on iron,

These became purple with a reddish cast.

Do. which had remain'd 4 { on standing, a beau-
days on iron, { tiful deep purple.

Do. kept four days corked, } on standing, a faint
in a cool room, but had let } blackish shade.
fall part of its iron,

Do. Do. with the addition } a good purple with
of fix'd air, } a reddish cast.

EXPERIMENT XVIII.

To have produced a positive, uncontrovertible proof of the presence of fix'd air, we should have shewn, that the vapor of the Spa Water suffices to restore to a caustic alcali, the fix'd air of which it had been deprived by the addition of lime. But the circumstances which render the detention of the fix'd air so difficult, have been already explained, and hence I need not scruple to avow, that I have more than once unsuccessfully tried the following experiment. A bent tube was passed through the cork of a quart bottle, carefully filled at the Spà early in the morning; the other end of it was inserted into a phial, containing caustic fix'd alcali, and the bottle after standing some time before the fire was put into a water bath; but I have not yet been lucky enough, by this means, to restore to the alcali, its faculty of effervescing with an acid, though it became turbid, and a partial precipitation of the lime took place, which are advances towards the state of a mild alcali, and owing to a small quantity of fix'd air, tho' not sufficient to saturate the alcali.

EXPERIMENT XIX.

Lime water, mix'd with an equal quantity of fresh Spà Water, caused a yellow ochrous precipitation; in consequence of the lime ab-

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sorbing

forbing the fix'd air, which is the solvent of part of the iron herein.

But as I fear I have already trespassed upon the patience of many readers on this matter, however interesting it may appear to some, I shall here drop the subject and proceed to,

§ 7. VIRTUES of the LIVERPOOL SPA' WATER.

THIS water then contains, beyond a doubt, iron dissolv'd, both by fix'd air, and by vitriolic acid : in this latter circumstance, having the advantage over Tunbridge, and most of our other chalybeates. This renders it not liable, like them, to deposite its metallic principle by keeping. Yet the martial vitriol is so very much diluted and so minutely divided, as to render it at once extremely beneficial, perfectly innocent, and adapted even to weak stomachs.*

* " They are a mild, native tincture of steel, having this peculiar excellence, that they agree with the most tender subjects, even where steel in substance is attended with ill effects ; and by the extreme subtilty of their parts, penetrate into the minutest vessels, as being a preparation of iron, infinitely more subtilized and attenuated, than in any of the preparations of that metal by art." Ratty on mineral Waters, p, 249. Virtues of Chalybeates.

There is also a small proportion of muriatic and earthy salt, mentioned above, but not in such proportion as to claim any share in the medicinal effects.

It is peculiarly adapted to promote appetite, and digestion, and to strengthen the tone of the stomach, impair'd by excess, or other causes. It gradually strengthens the whole habit, and hence is excellent in that weakness, which remains after acute diseases, and for those who, without any apparent cause, lose their strength, fall away, and are commonly said to be going into a weakness. It is useful in the first stage, or beginning of consumptions, and may be used with advantage, even in the more advanced stages, if the matter spit up be good pus, and there be no considerable degree of fever.

It is of great service in nervous diseases, and in such as arise from weakness of the system, and reciprocally serve to increase it, as in the beginning of a dropsy, in the Fluor albus, or other seminal weaknesses, Diarrhæa, and Diabetes.

It is good to prevent the gout in the stomach and bowels, may be useful in rheumatisms, and in some bodies to remove the causes of barrenness or imbecillity. In general, it will be serviceable

in a relaxed state of the solids, arising from luxury, or excess, inaction, or a sedentary life, or consequent on some disease: it will correct a bad habit of body, and promote good suppuration and granulation in ulcers; and its frequent use will render a person less liable to be affected by cold, damp, or putrid air, epidemical or other causes of diseases. It will prove an efficacious medicine in all the cases which were mention'd under the article of iron, p. 24, 25.

If the escape of the fix'd air was prevented, we might also expect from it, in part, the virtues ascribed to that pervading principle. It may perhaps sometime prove of consequence enough, to have some care taken to preserve its virtues entire, to be render'd (as it easily might) more commodious and easy of access, and to make it a matter of general joy, that a medicine of such public utility, is not in the hands of private men, who might circumscribe its use, but a part of the public estate and free to all comers.

U N F I T.

These waters are unfit for old, infirm, persons who have not heat enough to promote their action. The same may be the case of some *very weak* habits, and to such the exhibition of
the

the water should be very gradual, and prudently regulated; it is not good for people, plethoric, fat, dispos'd to inflammation or spasmodic affection: and generally, where it heats much, it must either be omitted, or taken with proper precautions. To some, a vomit, bleeding, or purging may be necessary, before entering on a course of this water; weak and delicate stomachs may require it diluted, or warm, or with the addition of a little aromatic, or stomach tincture; and in some, particularly the consumptive and gouty, it will be proper to drink it with milk. Bark infused in it will in some cases be of service. The body should in general be kept moderately open during its use.

THE METHOD OF USING THE WATER

The best time for drinking this water is when the stomach is empty, in a morning, or an hour or two before dinner. It is proper to begin with half a pint, or a pint, and gradually to increase the dose, so as to take in some cases four or five pints a day, or even to use it for common drink at meals. The use of it should be continued for a pretty long time to reap the benefit of it, and where the quantity drank has been gradually increased, as soon as the end proposed is obtained, it shou'd be gradually decreased, though not perhaps entirely left off. The summer

mer season is the best for drinking it, altho' the chief reason for this is, that it is the fittest for exercise and bathing, which greatly promote the good effects of the water, especially in nervous cases: this is also one motive for advising its being drank at the spring, rather than at home. Moderate exercise, regularity, temperance, a light, simple, diet, not flatulent, using but little animal food, malt liquor, tea or coffee, and relaxation of the mind, also contribute much to assist its operation; as does, in obstructions, the warm bath.

§ 8. . C A S E S.

AS a confirmation of what has been advanced of the good effects to be expected from the Liverpool Spà Water, I determined to collect some cases of persons cured by its use, and to lay before the public such of them, as evinced most clearly its efficacy. The three following, which I received from the patients, or their family, deserve particular attention, both by reason of the confirm'd state of the disease, the imminent danger of the sick, and also as no other remedy being used at the same time with the water, there is sufficient reason to attribute to it alone, the surprizing change brought about in the general state of health of each.

CASE

C A S E I.

Miss Knowles, daughter of Mr. Knowles, in Castle Ditch, had a sister, who three years ago died of a consumption at the age of sixteen. About a year afterwards, she herself, then twenty years old, was observed to be in a decline. She complained of a bad cough, and great pain in her side. She lost her flesh and her appetite entirely, and was despaired of by the physicians, whose advice she followed long, but without benefit. Her father, tho' he believed there were no hopes remaining, yet recollecting that he had heard some favourable accounts of our Liverpool Spà Water, determin'd she should try that. He carried her up to it every morning, at first with great difficulty. Within three days, however, she perceived good effects from its use, and by a continuance of it, her appetite return'd, her digestion was rendered good, she recovered her flesh, and strength, and is now perfectly well; yet still continues to drink the Spà Water occasionally, and attributing the preservation of her life, and the recovery of her health solely to its use, has recommended it to numbers of people, who have also used it with considerable benefit.

C A S E II.

Miss Moss of Middlewich, now Mrs. Eaton of Chester, when about twenty, was thought to be in a consumptive state. For two winters she

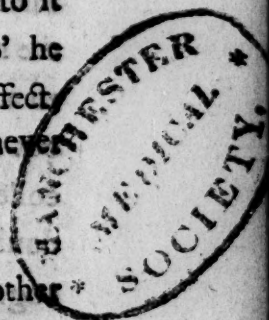
she had been extremely emaciated, and had lived only on chocolate and oysters. She had so great a difficulty of breathing, and such violent pain in her side, as obliged her to walk bent double, and to seek relief from repeated bleeding, even twice in a day. Her father (a judicious apothecary of Middlewich) almost despairing of her life, sent her to Liverpool on purpose to drink the Spà Water. She continued its use for some time with considerable benefit (taking no other medicine) and though her complaints were, both in their nature, duration, and violence, such as seemed to preclude every chance of recovery, yet she was soon restored to perfect health, and is now remarkably well and lusty.

C A S E III.

Mr. Joseph Halfworth, aged about 50, brother-in-law to Mr. Yates, seedsman in Castle-street, for many years had laboured under a total want of appetite, digestion, and proper excretion, inso-much that frequently for a week together, he had no stool. Scarce a day passed but he vomited up a quantity of a black watry fluid, especially in an evening, and suffered grievously from a violent griping and twisting pain of the bowels, and at the pit of the stomach. For the last ten years he had been much emaciated, and entirely incapable of working, or undergoing any fatigue. In this situation he came to Liverpool,

verpool, and in October 1772, began to drink our Spá Water, induced by the many accounts he heard of the good effects it had produced. In a few days after he began to use it, his body became regularly open, his digestion good, his daily vomitings and colicky pains ceased entirely, his appetite returned, he recovered in a short time his flesh and strength, and has ever since remained in a good state of health. He still continues to drink the water daily, and ascribes to it alone the cure of his complaints; for, tho' he had tried abundance of medicines, without effect before he began to drink the water, yet he never afterwards made use of any.

To these I might add a number of other cases, less remarkable, in which it has been found of signal service, but as I think the above sufficient to prove its efficacy, and such as are both perfectly indubitable and satisfactory, I suppress many accounts I have received of persons who have been cured or relieved by the Spá Water, in cases of loss of appetite, vomiting up the food, and general debility. Instances of this kind must have occurred to most of my readers, within the circle of their acquaintance. Many such I have seen; particularly a friend of mine, who could never eat at breakfast when he omitted drinking the water; and a per-



son troubled with indigestion and frequent vomiting, who, tho' he is so situated as to have the water brought to him, finds great benefit from its use. But surely, enough has been said, to justify a trial, and to prove, that 'tis no inconsiderable remedy in many cases.

Thus have I endeavoured to explain clearly and intelligibly, 1. the component parts, or chemical principles of the Liverpool Spá water, 2. the medical virtues and good effects to be expected and derived from its use; and after pointing out the cases in which it may be of service, 3. collected instances in which it has.—I make no doubt, but these might have been considerably augmented, and abundantly confirmed, by waiting to observe the success attending fresh trials of it, and that thus, this work might have appeared less incomplete and incorrect; but, as the season for making use of it is now present, I chose rather to submit these observations to the public, crude and imperfect as they are, than to defer exciting them to make trial of a remedy, in every ones power, highly useful, and at once unexpensive and agreeable; happy if this attempt may prove, in any degree, serviceable to society.

*Da veniam scriptis, quorum non gloria nobis
Causa, sed utilitas, officiumque fuit.*

Ovid. 2. de Pont. Eleg. 9.

APPENDIX.

On the ACCIDENTAL Use of LEAD.

Tanto pejus afficit, quo irrepit testius.

BOERHAAVE, Elem. Chem. V. 2.

HAVING said so much, on what may not improperly be termed a *domestic medicine*, I shall take this occasion of cautioning the public against a *domestic poison*, the more to be apprehended, as its attacks are unperceived, and unsuspected, and its effects truly deplorable. Add to this, that there are few families, into which it does not, one way or other, find admission in a greater or less degree, and that, even in *very minute quantities*, it has been known to produce its bad effects on particular delicate constitutions. The pointing out so dangerous an enemy is of too much importance, not to render any apology unnecessary, for annexing to this treatise, a few words on a subject no way connected with it.

LEAD, by whatever means, or in whatever form it gains admittance into the human body, is found to produce dangerous or fatal effects. This seems to have been well known and perfectly understood even by the antients; and Pliny, *Ætius*, *Paulus Ægenita*, and *Vitruvius*, have considered Lead as highly poisonous. The Italians, French, &c. have long been wholly indebted to this metal, for those slow poisons, which were in former ages so frequently administered, and which have render'd those nations so deservedly infamous. By preparations of this metal they knew how to ensure death, even at a distant period from their exhibition, or, by a continued, imperceptible, repetition of small doses of them, to destroy, without suspicion, or the possibility of detection. Shall we not then be astonish'd at being inform'd that we often are daily, of our own accord, swallowing small doses of this poison, against which we ought ever to be upon our guard?

We are indebted to the learned Dr. Baker for evincing, that the poison of lead may, and frequently does, gain admittance into the human body, unobserved and unsuspected. The Dr. has also been at great pains to caution the world against it, by pointing out the dangers

dangers attending it, and the various modes by which it may casually gain admittance into the body ; some of which are as follows.

1. In wines or cyder, with which lead is too frequently combined (particularly with the poorer, weak, acid, kinds) either intentionally and *fraudulently*, *casually* and unnoticed, or *unskilfully*. It has long been a practice with the makers or dealers in wine, when they find it poor, and disposed to turn sour, to add to it some Cerusse, Litharge, sugar of Lead, or other preparation of that metal ; a practice, of which the noxious effects were so notorious, that it was prohibited in France and Germany since the year 1487, under pain of death. Yet, notwithstanding people are well apprized of the poisonous qualities communicated to the wine by this mixture, it is not uncommon to find the small, weak, white wines (as Lisbon, Rhenish, Moselle, French white) thus adulterated. It were well, if the Cyder-makers or venders were wholly free from this imputation. Certain it is, that cyder is often found adulterated with lead or its calces, which at once takes off any acidity it may have acquired, gives it a rich luscious taste, checks its fermenting, and improves its colour. These effects have often given rise to the intentional and *fraudulent* mixture. But besides this, the same
poison

poison has been frequently added unknowingly and *undesignedly*. If any lead vessels be used in the preparation of cyder (as about the trough, press, cistern, spouts &c.) the native acid of the apple dissolves the metal, and forms with it sugar of lead, of which so small a portion, as six or twelve grains, has been known to produce the most terrible effects. In Devonshire particularly, lead was frequently employ'd in preparing their cyder, and hence the metallic colic is endemial, and the other effects of this poison more frequent in that county, and the colic has obtain'd amongst us the name of the Devonshire colic. Lead has also sometimes been combin'd with cyder, made-wines, &c. *unskillfully*, by persons appriz'd of its correcting, and ignorant of its poisonous, quality. Thus hanging a lead weight, or putting lead melted and pour'd into water, in the cask; decanting the liquor into a leaden cistern; boiling it, before fermentation, in a copper, the upper part of which is of lead; and even adding litharge; have been practised, and advised, as useful improvements, to the great detriment of the families who have adopted this custom, which, tho' recommended in some cookery books, as a piece of good housewifery, for correcting any acid tendency in wine, cyder, &c. has repeatedly proved fatal. Several instances are produced by Dr. Baker of
metallic

metallic colics, palfies, and death, evidently occasion'd by this undesigned adulteration. Dr. Warren also mentions, that in the late Duke of Newcastle's family, when at Hanover, in June 1752, thirty two persons were seiz'd with the metallic colic, after having drank a small white wine, adulterated with lead. One of them died epileptic in less than a fortnight, the rest, after suffering much and relapsing frequently, recover'd, except one, who remains paralytic. Even shot remaining in bottles, and corroded by the liquor, may be of bad consequence. For certain it is, however the internal use of lead, as a medicine, may have been inculcated, in particular circumstances, by some medical writers, it will generally be found to be, of a most dangerous tendency.

The common wine measures are made of base pewter, in which is a considerable proportion of lead. Wine, cyder, or vinegar may prey upon these, and thus accidentally acquire a dangerous adulteration. The same happens frequently from keeping these liquors in, or drinking them out of, common glazed earthen vessels.

The common black glaze is little else than an imperfect vitrification of lead; the common yellow

yellow glaze, only a glass of lead. A small portion of lead is employ'd in glazing the earthen ware, call'd Queens Ware, but is much more difficultly soluble than in the two former. Stone and flint ware only have a natural glaze, the earth being vitrified by the addition of salt. The lead is readily soluble in any acid liquor, and such solutions become highly dangerous. We all know, nothing is more common than to keep pickles in black glaz'd earthen vessels; yet I believe it might be easily proved, that vinegar long kept therein, dissolves enough of the lead, to render it not only an actual, but an active poison. This kind of glazed earthen ware (and sometimes Pewter) is often used here by the common people to bake fruit pies in; and it is observed, that the acid fruits take less sugar to sweeten them, when baked in such. The native vegetable acid, in this case, dissolves a part of the lead, and is thereby corrected; but whoever is aware of the terrible effects, which the sugar of lead, thus form'd, may produce on the health, will always guard against a practice, which to the generality appears both innocent, eligible and useful. Keeping milk, buttermilk, sweetmeats, syrups, or even moist sugar in this kind of glazed earthen ware, is not void of danger, as, by any thing disposed to turn acid, the glaze will be dissolved. On the same principle

ciple nothing can be more improper than such vessels, as are in general use amongst us, for fermenting small wines, as ginger wine, and treacle drink. These large drink-pots, as they are called, are glazed on the inside with the common black glaze, and, as the small wines fermenting in them are, both from their weak nature, and the hot season in which they are chiefly used, particularly disposed to become acid, this prevailing custom should be exposed as highly dangerous: and though it may not have been productive of consequences immediately alarming, yet it may have frequently given rise to weaknesses of the digestive faculty, loss of appetite, and complaints of the stomach and bowels, which were never suspected to arise from this cause. Altho' some constitutions may, perhaps, not be injured by such repeated small doses of this poison, yet in delicate ones it may exert all its baneful influence: hence no one should expose himself to it unnecessarily, and humanity requires our cautioning those ignorant of the danger, against it. Nor are the common glazed platters proper for baking or salting meat, as the lead is soluble in greasy substances, and may be corroded by the salt. Glass, stone, and flint ware, being void of danger, should be substituted instead of glazed vessels for the above purposes.

It is almost a constant practice to prepare our food, in copper vessels *tinned*; the metal with which they are lined, consists of above $\frac{1}{2}$ part of lead, which dissolves not only in acids, but even in oil, butter or grease, particularly if suffered to stand in them.

I have been assured by Professor Gaubius, in Holland, that the people there, have sometimes endeavoured to encrease the weight of their butter, by adding to it a calx of lead; but I hope, and believe, no such diabolical practice prevails in England.

New rum is found to be also accidentally impregnated with lead, and to produce the metallic colic, or dry belly-ach, as it is call'd in the West Indies, where it is frequent from this cause; not, as was suspected, from the great use of acids: for acids are even found to be the best defence against the bad effects of such solutions of lead. But when it is known, that "the juice of the sugar-cane, when expressed, flows into a vessel lined with lead; that leaden gutters, or pipes, are used to convey it to the boiling house, and the skimmings and molasses from thence to the still-house; that the sugar coppers are rimmed with lead; the still is copper, tinn'd; and the still-head and worm are of tin or common pewter, and the latter (till of late years) of lead,"

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it will not be wonder'd at, if new rum should be found to contain a portion of this metal. By keeping the rum (as also wine and cyder) this is decomposed and precipitates, so that these liquors grow less dangerous on that score by age.

Lead, in general, is not dissolv'd by water, but sometimes, by long standing and attrition, is mix'd with, and suspended in it, in a very fine powder, by no means innocent, tho' not near so dangerous as when 'tis dissolv'd by an acid. It is not however quite clear, that certain waters may not be impregnated with acid, or saline, principles, which may render them capable of dissolving lead, and thus becoming an active poison. Dr. Wall gives an instance of a gentleman of Worcester, who had twenty children, of whom eight died young. The rest during their infancy, and until they quitted the house they liv'd in, were all remarkably unhealthy, and subject to disorders of the stomach and bowels. The father was many years paralytic, the mother, subject to colics and bilious obstructions (which were relieved by Bath waters, but return'd when she came back to her own house) died of the jaundice. When the house was sold, and the lead pump came to be repair'd, the cylinder was much worn, and the cistern was so corroded as not to be thicker than paper, and was full of holes,

though the pump had been several times repair'd, even but 3 or 4 years before, when it was nearly in the same state. The water of that place is very hard, and hence probably corroded readily the lead, and becoming strongly impregnated with that metal, was the unsuspected cause of the ill health of this family, for many years.

As this circumstance may cause a distrust of the water with which many families are supplied, I shall here add an easy method, by which the mixture of lead with other substances may, at any time, readily be discovered. Take pot ash, and sulphur, equal parts, and boil them together in water for half an hour : add, very gradually, a little of this liquor to the water you would examine, and a cloudiness will appear ; if lead is contain'd, the colour, and precipitated powder, will be dark grey ; if no lead be contain'd, they will be white and milky ; and the darkish shade will be greater or less, in proportion to the greater or less quantity of lead contain'd, as may be seen by adding a little sugar of lead, to water intended for examination and comparison.

A caution seems to be necessary against feeding children with pewter spoons, which are made of base metal, contain much lead, and
are

are too often suffer'd to stand in the milk, &c. which the child takes: as also against giving them toys daub'd with paint to amuse them, in which lead has a great share; young children generally putting into their mouths whatever they have in their hands. Hence, not improbably, may arise many of those complaints in the stomach and bowels which are frequent in infants, who will be much easier affected, than others, by the noxious metal. Nor must we lose sight of this, that, as the action of this poison is on the nervous system, its effects will be very different in different constitutions, and the same dose will frequently cause no sensible bad effect on some, which may suffice to produce the most deplorable evils, and even incurable complaints in others. And hence it is, that these consequences of an accidental use of lead are not so general, as we might otherwise expect them to be.--But as a proof that these combinations of lead are not supposition only, real lead can be obtain'd from them.

Lead even externally applied has proved hurtful, altho' it is the basis of an external remedy against inflammation, &c, which is of infinite use when prudently administer'd, acts on the nervous system, and takes off inflammation, ob-
tunding the sensibility. A piece of sheet lead worn upon an issue, a plaister of which lead is
the

the principal ingredient, a poultice, or an injection of a solution of lead, have, in certain irritable habits, produced effects, similar to those consequent on the internal use of it. Even dusting the excoriated parts of children with white lead, has been known to cause convulsions.

The complaints consequent on the use of lead, are frequent amongst those whose business exposes them to the action of this metal, as plumbers, potters, painters, glass-grinders, &c. Even printers by using their types, when too much heated in drying, have been known to feel the bad effects of the effluvia of lead. For "lead whether dissolved by fire or corroded by an acid, emits poisonous effluvia." In the cutting of glass a leaden wheel is used, and the vapor arising from thence is known to be highly hurtful to the workmen employ'd at it, who are subject to the metallic colic, and frequently become paralytic. By a greater degree of heat, lead emits more and more dangerous effluvia, which act often with equal, if not greater violence, than its preparations taken internally. Even the heat of the atmosphere alone causes it to emit a baneful vapor. Instances are not wanting where living in a room which has been newly painted (especially white) has caused these complaints, and birds, &c. shut up in it, have died. The vapor from
oil

oil-cake (which has sugar of lead in its composition) may produce inconveniences to delicate habits, particularly to such as wear socks of it.

The *effects* consequent upon this accidental use of lead, are, obstinate constipation, with violent colicky pains (the Colica Pictonum, Devonshire, or, more properly, *metallic colic*) and consequent paralytic affections, resolution and loss of colour of the muscles, pains, tremors, spasms, suppression of urine, asthma, suffocation; vertigo, epilepsy, apoplexy, idiotism; pulmonary consumption, slow fever and death.

Those whose employment exposes them to the action of poisonous metallic effluvia, as those who work in lead mines, copper works, &c. find the best preventative to be greasy substances, as fat broth or oil taken every morning, and thus they are in some degree defended against its baneful influence.

For the *cure* of the metallic colic, recourse is had to the Cremor Tartari, Castor Oil, sometimes to the quick, active, purgatives, emetics opiates and glysters. The Bath waters are found very serviceable in palsies consequent on this metallic colic. Very excellent effects are related by Graßhuis, and after him, by our ingenious coun-

countryman Dr. Percival of Manchester, from roch alum, fifteen grains, given every four or five hours, in the metallic colic, which the latter says has, in fifteen cases, succeeded with him, relieving the pain, and the second or third dose proving aperient.---But nothing gives so immediate temporary relief, as the warm bath; yet it should be long continued, and occasionally repeated, to prove of permanent advantage. Its use calms, removes spasms, and disposes the body to be sooner acted upon, by the medicines employ'd to get the better of the constipation.

A woman of this town, from the use of paint was afflicted grievously with the metallic colic, and had, for several days, tried a variety of means to procure relief, under the direction of a skilful and experienced physician, but with little success. Despairing almost of his patient's recovery, he mention'd the case to me, and we jointly determined to try the warm bath. She sat in it near an hour, and experienced an almost immediate cessation of pain; and though this was not durable, a repetition of the warm bath, with proper aperient medicines, soon effected a cure. It is remarkable, that in the same house, from the like custom (painting) there were two women subject to epileptic complaints.

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As the practice of painting the face, is by no means prevalent here, I thought it unnecessary to add any caution on this head. But it may not be amiss to remark, that in France, where this custom is general, they themselves are sensible of the mischiefs occasion'd by it, particularly by the cheaper and more ordinary kinds of *rouge*, which consist chiefly of lead. But the greatest danger to be apprehended is from the *white*, which they rub into the skin, to hide the natural dimness of their complexions.

Nor are the ill effects of this metal confin'd to man alone : the brute creation are equally liable to be affected by it, from accidental causes, as feeding from leaden vessels, or drinking water impregnated with lead. The cattle which feed, or drink, in the neighbourhood of furnaces for smelting lead, and the cats of plumbers, and others who work in lead, are remarkably subject to colics, and to a gradual decay.

Thus have I cursorily enumerated, the various means by which the poison of lead may, and does insinuate itself into the body, and endeavour'd to caution the public against a dangerous and unsuspected enemy; and I would humbly hope, that, however foreign from my subject this may appear, the attempt will, in some degree, prove both agreeable and serviceable to my readers.

As a matter of fact, the fact is by no means
uncommon, that I find it is impossible
to add any number on this point. But it may
not be true to think that in France, where
this custom is general, the individuals are in
the of the human race, and by it, and culture
by the light and more ordinary kinds of
ways, which account for the of fact. But the
greater danger to be apprehended is from the
fact, which has to do with the fact, to which
natural objects of the of fact.

For we are all effects of the of fact, and
to men, from the pure cause and copiously
able to be affected by it, from the of fact, and
as from the of fact, and from the of fact, and
for instance, which leads to the cause which
lead, or think, in the neighborhood of fact, and
for instance, which leads to the cause of fact, and
others, which work in fact, are remarkably sub-
ject to the of fact, and from the of fact.

There have been many attempts to the various
branches of the of fact, and from the of fact, and
indicate in it the of fact, and from the of fact, and
to caution the public against the of fact, and from
instructed a class, and I would humbly hope
that, however foreign from my subject in a way
opposed the attempt will, in some degree, prove
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